Reconsideration of Mimesis in Drama through the Perspective of Mirror Neurons

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Abstract Mirror neurons are active both when an action is performed and when one is observing another's action. They can simulate the perceived action as mirrors. Mimesis in drama, based on mirror neurons and connected with the basic instincts, provides much pleasure. Mirror neurons form the basis for understanding and learning in drama and make empathy possible, with some other neurons separating the action of one's own from the action of others. Inspiration comes when someone's action is mainly directed by mirror neurons; inner feelings and outer expressions are closely connected; drama purifies the feelings of the audience in the short- term, but strengthens them in the long-term.[1]

Key words mirror neurons; drama; mimesis

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Miraculous neurons are discovered by Di Pellegrino and his Italian colleagues, which are active while a person is both acting and observing, therefore are named "mirror neurons." They can reflect the acts of others simultaneously just like mirrors, providing the physical basis for learning and understanding others. In an essay on the Edge website American scientist Vilayanur Ramachandran wrote：
"I predict that mirror neurons will do for psychology what DNA did for biology: they will provide a unifying framework and help explain a host of mental abilities that have hitherto remained mysterious and inaccessible to experiments" (http://

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www.edge.org/3rd_culture/ramachandran/ramachandran_p1.html). This discovery has been highly valued by many other scholars. A completely new perspective of understanding human psychology has been provided by mirror neurons, which can also be appropriately used to study the mimesis in drama.

I. Discovery of Mirror Neurons

In the early nineties of the last century, the Italian scientist Giuseppe Di Pellegrino and his colleagues made an interesting discovery: neurons of area F5 of the premotor cortex of the monkey discharge while it is performing goal-directed hand movements, such as grasping, holding, and tearing, and many of these neurons are also active when the monkey observes specific, meaningful hand movements performed by the experimenters (176). They were very excited, and decided to give them the name "mirror neurons" in 1996, after another several years of research.

A group of scientists led by Evelyne Kohler have made experiments to see if the mirror neurons of the monkeys discharge when they hear someone acts. It is proved that the monkeys' mirror neurons are active when they hear the voice of tearing paper, without seeing the act (846). So another important aspect of mirror neurons is revealed. Then Christian Keysers' teammade another interesting discovery: "The monkey could therefore on average differentiate the two tested actions with a performance of ~90% correct based on vision or sound alone, and 97% correct based on the combined vision and sound of the action, if he/she only used the firing of a single audiovisual mirror neuron to take this decision" (634). So it is more reliable to use both vision and sound to make judgment.

Rizzolatti's group continued the experiment with human being, and found similar neurons. Many of the mirror neurons are in the Broca's area, which is similar to area F5 of the premotor cortex of the monkey, but they are more complicated, and can also be found in other areas (137-138). This discovery is very important for the understanding of the human mind.

Imitation of action is also very important for drama. Aristotle said: "A tragedy then, is the imitation of an action that is serious and also, as having magnitude, complete in itself…"(*De Poetica* 1449^{b}). Can we use the imitation theory in neural science to study the imitation in drama? It seems to be an interesting theme.

II. Origin and Pleasure of Drama

People in ancient Greece believed that drama originates from imitation. Aristotle once said: "Epic poetry and Tragedy, as also Comedy, Dithyrambic poetry, and

most flute-playing and lyre-playing, are all, viewed as a whole, modes of imitation" (*Politica* 1447[a]). His teacher Plato said: "You could do it quickly and in lots of places, especially if you were willing to carry a mirror with you, for that's the quickest way of all. With it you can quickly make the sun, the things in the heavens, the earth, yourself, the other animals, manufactured items, plants, and everything else mentioned just now" (*Republic* 1201). Plato thinks that literature can reflect reality just like a mirror. This theory is similar to mirror neuron theory to a certain degree; therefore, it is possible to compare them.

Why do we like imitation in drama? Aristotle once said: "Imitation is natural to man from childhood, one of his advantages over the lower animals being this, that he is the most imitative creature in the world, and learns at first by imitation. And it is also natural for all to delight in works of imitation" (*De Poetica* 1448[b]). According to Aristotle, human beings are naturally imitative, and they can find a lot of pleasure in imitating.

Is it out of human nature to imitate? De Renzi's team have discovered a disease called Imitation Behavior (IB). The people, who suffer from IB, will imitate other's behavior automatically, although they are not asked to do so; they will continue with the imitation, even when they are asked to stop (396). Although the sufferers seem to be very clumsy, they can still imitate. There is another disease called apraxia. Patients with apraxia can not act according to linguistic direction, but they can imitate other's acts. Michael Arbib thinks such movement imitation is the "residual ability" of human beings (202). Patients with these diseases can still imitate, although they have lost a lot of other abilities, therefore imitation is one of the basic instincts of the human beings. And this instinct is based on mirror neurons, which function all the time without being conscious of.

Aristotle also suggests that to follow one's nature is a pleasure. This idea is reasonable. It is a pleasure to eat and drink, because they are natural desires. To imitate is out of human nature too, so it is also pleasant.

Aristotle's explanation of the origin and pleasure of drama is quite appropriate. Perhaps he never expected that modern neural science can prove the correctness of his judgment.

III. Understanding and Learning in Drama

An important function of mirror neurons is to make the understanding of other's act possible. Rizzolatti's team have made interesting discoveries: "The movement representation in the cortical areas and the movement consequences are associated… When an external stimulus evokes a neural activity similar to that which, when

internally generated, represents a certain action, the meaning of the observed action is recognized because of the similarity between the two representations, the one internally generated during action and that evoked by the stimulus" (137). Just because of mirror neurons, the understanding of other's act becomes possible. Although this process is very important, it is without self-consciousness and effort. Lepage and Théoret think that we're executing the act in the brain while we're observing, therefore we can naturally understand the act, so the whole process can be described as "perceiving is doing" (519). Though it is done subconsciously, it is famous for its complexity, including ''what another person is doing, what another person ought to do, and what you yourself intend to do'' (Wilson 215). For example, if a boxer sees the opponent punches, his mirror neurons can judge the angle and strength instantaneously, and decide how to answer it. If it is to be calculated by computers, it needs a lot of information, and takes a long time. But the mirror neurons can finish the complicated task simultaneously without any conscious effort.

Another function of mirror neurons is to provide the basis of learning. Judy Cameron of Oregon National Primate Research Center, after a long time of observation, discovered: It took 5 months to train the first batch of monkeys to run on a treadmill. But the naïve monkeys would run successfully the first time they were placed on a treadmill, if they were allowed to observe the trained monkeys running on the treadmill (18). While monkeys are observing or listening, the mirror neurons are having a kind of covert imitation, which can be turned into overt imitation, if conscious imitation is necessary.

For the human beings, the training of the mirror neurons can also improve the outer movement. Giovanni Buccino and his team have tried to rehabilitate patients with motor impairment of the upper limb after stroke. They first let the patients watch videos with a lot of the action of the upper limbs, instructing them to imitate in the brain, so that neural system's ability to control and coordinate may be strengthened; then they ask the patients to move the limbs gradually; the experiments make the patients recover rather quickly (61). It is difficult to recover for the patients with upper limb stroke, but their mirror neurons are still active, they can be trained to activate the limbs rather efficiently.

Although the mirror neurons of the spectator of a boxing game discharge almost the same way as the athlete who is imitating his teacher to box, the former has just inner imitation, while the latter has both inner and outer imitation. What makes the difference? According to Fausto Baldissera's team's experiment, the recorded H-reflex rapidly increases in size during hand opening, it is depressed

during hand closing and quickly recovers during object lifting; this modulation pattern is, however, opposite to that occurring when the recorded muscles are actually executing the observed action. So they think there is a spinal "inverted mirror," to prevent the overt replica of the seen action (190). Without this mechanism, the observers will not be able to control themselves.

While we are watching the actors moving on the stage, we can easily understanding the play, and even judge who acts well, who doesn't. To judge the meaning of an act for the computer is difficult enough; to judge whether the act is good or not, is almost an impossible task for it. Thank god, we have mirror neurons; we can enjoy drama at our pleasure.

Without the function of mirror neurons, perhaps we cannot understand the play. J.H.G. Williams and his colleagues believe that "some dysfunction in the MN system might be implicated in the generation of the constellation of clinical features which constitute the autistic syndrome" (291). Because of the dysfunction of mirror neurons, it is often difficult for the people with autism to understand literary works. One autistic person once said: "[I]t happened to me and I find it hard to imagine things which did not happen to me" (Haddon 5). So the appreciation of a play will be impossible without mirror neurons.

Mirror neurons can also help us to learn something new. Philip Sidney said:"For these, indeed, do merely make to imitate, and imitate both to delight and teach, and delight to move men to take that goodness in hand, which without delight they would fly as from a stranger; and teach to make them know that goodness whereunto they are moved: — which being the noblest scope to which ever any learning was directed, yet want there not idle tongues to bark at them" (10). Plays can "delight and teach," they are interesting, therefore it is easier for the audience to learn in the theater. But we cannot expect to become ballet dancers just by watching, but watching really leaves something in our brain. So drama should be listed as a part important of education for us human beings.

IV. Inspiration and Mirror Neurons

Plato once said: "As I said earlier, that's not a subject you've mastered — speaking well about Homer; it's a divine power that moves you, as a 'Magnetic' stone moves iron rings…This stone not only pulls those rings, if they're iron, it also puts power in the rings, so that they in turn can do just what the stone does — pull other rings — so that there's sometimes a very long chain of iron pieces and rings hanging from one another" (*Ion* 941). Plato continues with the topic: "And you know that this spectator is the last of the rings, don't you — the ones that I said take their power

from each other by virtue of the Heraclean stone [the magnet]? The middle ring is you, the rhapsode or actor, and the first one is the poet himself" (*Ion* 943). The "divine power" described here refers to inspiration. It is not something mysterious, which comes just because we have meditated and observed long enough, and relevant mirror neurons have been trained, without being noticed on the conscious level. When these neurons are strong enough, they suddenly influence us, with much surprise.

Inspiration is very important for the poet and the actor, sometimes they are even "possessed by Bacchic frenzy" (Plato, *Ion* 942). This state of "Bacchic frenzy" is subconsciously controlled by mirror neurons. But they don't just depend on inspiration, techniques are also needed, thus they have to observe carefully and practice repeatedly, with much conscious effort. When they are imitating on purpose, their mirror neurons are also active. According to Marco Iacoboni's team, the mirror neurons are more active when they are acting than when they are just observing, and that they're even more active when they're imitating (observing + acting) (2526-2527). So mirror neurons are essential to the process of creating and acting.

Unlike the writers and the actors, the audience usually don't have to spend any effort to imitate, they enjoy the entertainment leisurely, mainly depending on the mirror neurons. But human beings like challenges, they often want to watch something that is a little difficult to understand. Plato said, "smallest infant children" like "puppets," "older children" will choose "comedies," "young men, ladies of cultivated taste" prefer to "tragedies," while "old men" want to listen to the recitation of *Iliad*, *Odyssey*, or an extract of Hesiod (*Laws* 1349). Throughout the life, the human understanding seems to be always "improving."

V. Feelings and Their Expressions

When one is angry, he will have angry expression, when one is happy, he will have happy expression. On the other hand, can the expression lead to relevant feeling? Edgar Allan Poe once said: "When I wish to find out how wise, or how stupid, or how good, or how wicked is any one, or what are his thoughts at the moment, I fashion the expression of my face, as accurately as possible, in accordance with the expression of his, and then wait to see what thoughts or sentiments arise in my mind or heart, as if to match or correspond with the expression" (12-13). Poe thinks that the inner feelings and outer expressions are closely related. Can it be proved by modern science?

Bruno Wicker and his colleagues have performed an important fMRI study.

They ask some participants to inhale odorants, and they produce a strong feeling of disgust. Then they ask some people to watch the video with the emotional facial expression of disgust. By observing such faces, the same sites in the anterior insula and to a lesser extent in the anterior cingulate cortex are activated. Therefore, they conclude: "Thus, as observing hand actions activates the observer's motor representation of that action, observing an emotion activates the neural representation of that emotion" (655). So by observing outer expressions, people can get similar inner feelings.

Furthermore, scientists discover that feelings can be influenced by controlling the expression. Strack, Martin, and Stepper try to facilitate or inhibit the contraction of the zygomaticus (smiling) muscle unobtrusively by asking participants to hold a pen in their mouth while they evaluate cartoons. Participants judge cartoons to be funnier when smiling is facilitated rather than inhibited (768). We can say that the inner feelings and outer expressions are closely connected, and that the former can lead to the latter, and vice versa. So modern scientists have proved Poe's idea is correct, though he was a writer of more than 100 years ago.

When one has got a certain kind of feeling, it is quite natural to have the relevant expression. So some people believe that the first thing for an actor to do is to experience the feelings and ideas of the characters. Stanislavski once said, "That is why we think first and foremost of the inner aspect of a role, that is of its psychological life which we create by using the process of experiencing. It is the most important feature of creative work and must be the actor's first concern. You must experience a role, that is experience feelings analogous to it each and every time you do it" (19). If the feelings have been appropriately experienced, it is quite easy to perform well. With the feeling in the mind, it is often natural to have relevant expressions.

But for some other actors, the inner world is not important. Craig said: "…the ideal actor, with his brain commanding his nature, has been Henry Irving. There are many books which tell you about him, and the best of all books is his face… To begin with, you will find a mask . . ." (12-13). He thinks that an actor should use his brain to control his feeling, his face should be like a mask, the only aim of this mask is to represent different meaning the actor want to express, and it should be free from feelings. He even wrote an essay called "The actor and the Uber-Marionette", which suggests the actor should be like a puppet for the director to manipulate. To train the outward expression is very important, not only because the audience understand the play by observing the expression, but also because the outer imitation makes the inner experience of feelings easier. To our surprise, the

two schools of performance can be reconciled scientifically.

VI. Empathy and Psychological Distance

Adam Smith once said: "When we see a stroke aimed and just ready to fall upon the leg or arm of another person, we naturally shrink and draw back our own leg or our own arm; and when it does fall, we feel it in some measure, and are hurt by it as well as the sufferer" (12). This phenomenon is often called empathy, which always appear in the theater.

The discovery of mirror neurons can give empathy a good explanation. Vittorio Gallese said: "Most importantly for our quest for a neural correlate of intersubjective identity, sameness of content is shared with different organisms. This shared semantic content is the product of modeling the observed behavior as an action with the help of a matching equivalence between what is observed or heard and what is executed" (175). The different spaces can be mixed: "These spaces are blended within a unified common intersubjective space, which paradoxically does not segregate any subject. This space is we-centric" (175). In this space，"[t]he self-other identity therefore preexists and further parallels the self-other dichotomy" (175). The mirror neurons form the basis of empathy.

Another relevant concept is chameleon effect. Chartrand and Bargh said: "The chameleon effect refers to nonconscious mimicry of the postures, mannerisms, facial expressions, and other behaviors of one's interaction partners, such that one's behavior passively and unintentionally changes to match that of others in one's current social environment" (893). Among all the relations, the most important one is, of course, marriage, and the chameleon effect is the most obvious between them. Robert Zajonc and his colleagueshave done such research. They said: "It was found that the greater the increase in resemblance of a couple over 25 years, the greater the couple's increase in self-reported happiness" (345). The physical basis for chameleon effect is mirror neurons.

Empathy is an important aspect between human beings, but people generally don't get confused between each other. De Vignemont and Singer have discovered that feeling empathy for another is a complex, multi-level process where the empathizer is in an isomorphic state, elicited by the observation or imagination of another person's affective state, but where one is however aware that the other person is the source of one's own affective state (435). Therefore, there is a psychological distance between the self and the other. Philip L. Jackson and his team have found neural evidence for empathy and psychological distance. They

said: "Both the Self's and the Other's perspectives were associated with activation in the neural network involved in pain processing, including the parietal operculum, anterior cingulate cortex (ACC; BA32) and anterior insula. However, the Self-perspective yielded higher pain ratings and involved the pain matrix more extensively in the secondary somatosensory cortex, the ACC (BA 24 a'/24b'), and the insula proper. Adopting the perspective of the Other was associated with specific increase in the posterior cingulate/precuneus and the right temporo-parietal junction" (752). Actually empathy and psychological distance can exist at the same time.

In order to play well, the actor should try to become the character through empathy. Aristotle said: "Given the same natural qualifications, he who feels the emotions to be described will be the most convincing; distress and anger, for instance, are portrayed most truthfully by one who is feeling them at the moment. Hence it is that poetry demands a man with a special gift for it, or else one with a touch of madness in him; the former can easily assume the required mood, and the latter may be actually beside himself with emotion" (*De Poetica* 1455[a)]. Empathy is also essential to the audience. In the theater, the chameleon effect is very obvious. Plato's phenomenon of "Magnetic" stone is actually a kind of chameleon effect. And to enjoy a play in the theater, multimedia is used, so effect is better than reading a play, which can be inferred from Christian Keysers' experiment.

And yet the audience hardly become the characters completely, which can be easily explained by the psychological distance. Furthermore, a play, which is imitated, is not something real, therefore it is more proper to cause distance. Plato said: "...imitation is a kind of game and not something to be taken seriously…" (*Republic* 1206). It is very interesting to note that even the monkeys can differentiate a game from something real. Rizzolatti's group have made such discovery: monkeys' mirror neurons immediately charge while observing human beings grasping something; if they're imitating the act without grasping anything, the mirror neurons don't charge (135-136). Sometimes the imitation can be very real, and yet scientists discover the imitated and the real are different. Hill and Craig said: "…faked pain expressions show a greater number of pain-related and non-pain-related actions, have a longer peak intensity and overall duration, and the facial actions observed tend to be less temporally contiguous than are those in genuine pain expressions. The differences between masked pain and neutral expressions were subtle, with a greater frequency of mouth opening and residual eyebrow movement in masked pain expressions. Thus, there is an empirical basis for discriminating genuine and deceptive facial displays" (135). It is more probable for imitated plays to cause psychological distance.

Dramatic effect is produced between empathy and psychological distance. By taking advantage of both, a dramatist can make his works more attractive.

VII. Purgation and Intensification of Feelings

According to Plato, if people often go to the theater, their relevant feelings will be strengthened. He said: "I suppose that only a few are able to figure out that enjoyment of other people's suffering is necessarily transferred to our own and that the pitying part, if it is nourished and strengthened on the sufferings of others, won't be easily held in check when we ourselves suffer" (Republic 1210). He used another example to support his idea. He said: "That's how it is with the Corybantes, who have sharp ears only for the specific song that belongs to whatever god possesses them; they have plenty of words and movements to go with *that* song; but they are quite lost if the music is different" (*Ion* 943-944). People can be more or less sensitive to something, just because they have more or less experience in it.

Plato's idea can be proved by modern science. Beatriz Calvo-Merino and his team have done such research. They said: "We found greater bilateral activations in premotor cortex and intraparietal sulcus, right superior parietal lobe and left posterior superior temporal sulcus when expert dancers viewed movements that they had been trained to perform compared to movements they had not" (1243). All the human movements and feelings are connected with different areas of the brain, if they are exercised again and again, the brain will be physically changed. The theater can thus intensify some feelings.

Contrary to Plato, Aristotle thought tragedies can purify the feelings, "with incidents arousing pity and fear, wherewith to accomplish its catharsis of such emotions" (*De Poetica* 1445[a]). He also talked about religious enthusiasts, he said: "Some persons fall into a religious frenzy, whom we see as a result of the sacred melodies — when they have used the melodies that excite the soul to mystic frenzy — restored as though they had found healing and purgation" (*Politica* 1342[a)]. After listening to the religious music, the enthusiasts will often calm down for the time being, but in the long run it can strengthen the feelings. Plato and Aristotle are talking the different aspects of the same phenomenon.

Imitation is not only an important issue in drama, it is also essential question in literature and arts. René Wellek said: "…the dominance of the concept of 'imitation' in all criticism theory since Aristotle testified to the enduring concern of the critic with the problem of reality" (223). As an important question, imitation has been discovered again and again for more than 2000 years, and yet it is still an interesting question through the perspective of mirror neurons.

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